Amendments to the Specification

Please insert the following new paragraph on page 1 before line 3.

This application is a division of Application No. 09/628,022 filed July 28, 2000.

The paragraph starting at page 3, line 22 has been amended as follows.

Further, according to another aspect of the invention, a printing method for printing on a printing medium ~~method employing~~ with a printing head, comprises the steps of:

feeding a printing medium toward the printing head;

initiating the feeding of a succeeding printing medium toward the printing head, after the feeding of a preceding printing medium is initiated and before a trailing edge of the preceding printing medium is detected at a predetermined position; and

feeding the succeeding printing medium so that a ~~feeding~~ leading edge of the preceding printing medium arrives at the predetermined position after the leading edge of the preceding printing medium is detected at the predetermined position.

The paragraph starting at page 8, line 10 has been amended as follows.

~~The~~ In the item 2), the printing of a preceding printing medium is completed and the feeding of a succeeding printing medium is begun while discharging the preceding medium. In this case, the current position of the preceding printing medium is calculated with executing the driving in the sub-scanning direction to discharge the preceding printing medium, and the driving for feeding a succeeding printing medium is begun at an optimal position. In this case, the operations having the highest priority are the prompt completion of the paper discharge, and termination of the paper feeding when the discharge process has been completed.

The paragraph starting at page 11, line 6 has been amended as follows.

In Fig. 1, a head cartridge (or head cartridges) 1 is positionally and exchangeably mounted on a carriage 2. The head cartridge 1 includes a printing head and an ink tank, and further comprises a connector (not shown) for receiving/sending various signals such as a printing head driving signal.

The paragraph starting at page 11, line 26 has been amended as follows.

As a pickup roller 31 is rotated, via drive gears, by a feed motor 35, printing media 8, such as a printing sheet or a thin plastic plate, are separately fed, one by one, from an auto sheet feeder (hereinafter referred to as an ASF) 32. Further, as a conveyer roller 9 is rotated, the printing medium 8 is conveyed (or sub-scanned) passing through a position

(a printing unit) opposite to a discharge port face of the head cartridge 1. The conveyer roller 9 is driven, via the drive gears, by the rotation of an LF (line feed) motor 34. At this time, the discrimination as to whether a printing medium has been fed, and the determination of the cue position of the printing medium 8 are done at the time ~~of~~ the feeding ~~are~~ is done when the printing medium 8 passes through a paper end sensor 33. The paper end sensor 33 is also employed to acquire an actual location of a trailing edge of the printing medium 8 and to calculate the current printing location based on the actual trailing edge position. It is noted that a back side of the printing medium 8 is supported by a platen (not shown) in order to provide a flat printing surface at the printing unit. In this case, each head cartridge 1 mounted on the carriage 2 is supported so that the faces of the discharging portions protrude downward from the carriage 2, and are parallel to the printing medium 8 between the two sets of rollers. The head cartridge 1 is an ink-jet head cartridge that employs thermal energy to eject ink and includes electro-thermal converting elements for generating the thermal energy. That is, bubbles are generated by film boiling induced by the thermal energy that is applied by the electro-thermal converting elements, and the printing head of the head cartridge 1 employs the pressure exerted by the air bubbles to eject ink through the discharging orifices for printing.

The paragraph starting at page 13, line 10 has been amended as follows.

In Fig. 2, a plurality of discharging orifices 22 are formed at a predetermined pitch on a surface of a discharging portion 21 that is positioned opposite, at

a predetermined distance (e.g., about 0.5 to 2.0 mm), from the printing medium 8. Electro-thermal converting elements (heat-generating elements) 25, located along a wall of each of the liquid paths 24 that connect a common liquid chamber 23 and the discharging orifices 22, generate energy to be used for ink ejection. In this embodiment, a ~~pint~~ print head 13 is so configured that the head cartridge 1 is mounted on the carriage 2, the discharging orifices 22 are arranged in a direction perpendicular to the scanning direction of the carriage 2, the corresponding electro-thermal converting elements (hereinafter also referred to as ejection heaters) 25 are driven (or energized) based on an image signal or an ejection signal, to ~~course~~ cause film boiling of ink in the liquid paths 24, and the pressure thus generated is used to eject ink through discharging orifices 22.

The paragraph starting at page 14, line 6 has been amended as follows.

In Fig. 3, a controller 100 is a main control unit, and includes a CPU 101, for example, a micro computer, a ROM 103, used to store programs, required tables and other fixed ~~data;~~ data, and a RAM 105, which has an area for developing image data and a work area. A host apparatus 110 is an image data supplying source ~~(may be~~ (for example, a computer for creating and processing image data for printing, or an image reader). The image data and other commands and status signals are exchanged with the controller 100 via an interface (I/F) 112.

The paragraph starting at page 14, line 20 has been amended as follows.

Sensors 130 are used to detect the state of the apparatus, and include the home position sensor 30 described above, a paper end sensor 33 for detecting the presence of a printing medium, and a temperature sensor ~~135~~ 134 provided at an appropriate location to detect an environmental temperature.

The paragraph starting at page 15, line 27 has been amended as follows.

The paper feeding sequence advances in order from Figs. 4A to 4E. In Fig. 4A, a preceding printing medium 8 is ~~sandwitched~~ sandwiched between the conveyor roller 9 and a pinch roller 50 and conveyed by their conveyance in the sub-scanning direction. In this state, the output of the paper sensor 33 still indicates that paper is present. In the conventional art, even if, by reading data in advance, it is ascertained that data to be printed on a succeeding printing medium 40 is present, the paper feeding should be resumed with the development of the data in advance, but the paper feeding mechanism ~~can not~~ cannot be driven for the succeeding printing medium 40 unless a trailing edge of a preceding printing medium 8 is detected. Therefore, a constant interval is always required before the preceding printing medium 8 passes through the paper sensor 33. As a result, in Fig. 4C, the feeding of the succeeding printing medium 40 is initiated and at this time, a distance represented by L appears between the printing media. Then, in Fig. 4D, the succeeding printing medium 40 passes through the paper sensor 33, which detects the presence of paper. Based on this timing the cue position of the succeeding printing medium 40 is calculated. And in Fig. 4E, the succeeding printing medium 40 reaches the cue position,

the conveyer roller 9 is halted, and the print cartridge 1 is driven in the main scanning direction.

The paragraph starting at page 16, line 27 has been amended as follows.

According to the conventional method, the development of data for the succeeding printing medium 40 is conducted precedingly and parallel processing is executed, so that overlapping is permitted in the data handling processing and fast consecutive feeding is enabled accordingly. In addition, since the feeding of the succeeding printing medium is initiated after an output of the paper sensor 33 is examined, precise paper feeding can be provided without overlapped paper feeding or the occurrence of paper jam. However, relative to the feeding time, the distance L is always required. When the paper sensor 33 is located closer to the feed roller 31, this distance L is reduced. However, since the feed roller 31 slips on the surface of a printing medium during the feeding process and an error in conveyed distance occurs, the error tends to become large when a printing medium must travel a long distance before it reaches the conveyer roller 9 after passing through the paper sensor 33.

The paragraph starting at page 17, line 19 has been amended as follows.

As an improved conventional method, information ~~concerniing~~ concerning the length of a preceding printing medium 8 is read in advance, and the feeding of a

succeeding printing medium 40 is initiated without considering a trailing edge of the preceding printing medium 8. According to this method, the succeeding printing medium 40 can be fed at a comparatively short interval L, while the paper sensor 33 is positioned near the conveyer roller 9.

The paragraph starting at page 18, line 26 has been amended as follows.

In Figs. 5A to 5E, consecutive paper feeding can be performed with only a minimum gap defined between a preceding printing medium 8 and a succeeding printing medium 40. In Fig. 5A, the preceding printing medium 8 has been fed and is being printed. Then, in Fig. 5B, the accumulated value of the distance by which the printing medium 8 has been fed after the printing medium ~~8~~, 8 passed the paper sensor (edge detection means) 33 is used to calculate the location of a trailing edge of the preceding printing medium 8 based on the length of the printing medium 8 obtained in advance. Then, in accordance with that calculation, it is ascertained that the printing medium 8 and the printing medium 40 are separated. Then, the paper feeding roller 31 is rotated, and the feeding of the succeeding printing medium 40 from the ASF is begun. In Fig. 5C, the absence of paper is detected after the preceding printing medium 8 has passed the paper sensor 33, and the succeeding printing medium 40 has been fed to a position immediately before the paper sensor 33. At this time, the location of the leading edge of the succeeding printing medium 40 already obtained from a value calculated based on the rotation of the paper feeding roller 31 is used, a check is performed to determine whether the trailing edge of the

preceding medium 8 has passed the paper sensor 33 and the absence of paper is detected accordingly. In this state, since the information on the length of the preceding printing medium is substantially the same as the actual length, the distance L between the preceding printing medium 8 and the regularly succeeding printing medium 40 is the same as ~~it is~~ was estimated.

The paragraph starting at page 20, line 4 has been amended as follows.

In this state, the succeeding printing medium 40 can be successive fed to the conveyor roller 9, without the ~~stop page~~ stoppage of the paper feeding. As a result, the printing media, separated with a minimum paper feeding interval, can be consecutively fed at high speed without paper overlapping occurring, while at the same time, precise control of the cue position of the succeeding printing medium 40 is ensured. Subsequently, in Fig. 5D, the preceding printing medium 8, which is not shown, has been discharged, and the succeeding printing medium 40 has been delivered to and positioned at the conveyor roller 9. In Fig. 5E, the paper feeding process has been completed and the printing is being performed.

The paragraph starting at page 20, line 18 has been amended as follows.

~~In~~ Figs. 6A to 6E ~~are depicted~~ depict the processings in the above-mentioned embodiment, which is performed when the actual length of a preceding printing

medium 8 differs from the length obtained in advance. In this embodiment, the actual length of the preceding printing medium 8 is longer than the length obtained in advance. In Fig. 6A, the preceding printing medium 8 has been fed and is being printed. Then, in Fig. 6B, the accumulated value of the distance by which the printing medium 8 has been fed after the printing medium ~~8,~~ 8 passed the paper sensor (edge detection means) 33 is used to calculate the location of a trailing edge of the preceding printing medium 8 based on the length of the printing medium 8 obtained in advance. Then, in accordance with that calculation, it is ascertained that the printing medium 8 and the printing medium 40 are separated. Then, the paper feeding roller 31 is rotated, and the feeding of the succeeding printing medium 40 from the ASF is begun. However, since the actual length of the preceding printing medium 8 is longer than the length obtained in advance, the preceding printing ~~media~~ medium 8 and the ~~succeding~~ succeeding printing medium 40 are fed ~~as they are~~ in an overlapped state. In Fig. 6C, it is calculated by the rotation of the paper feeding roller 31 that the succeeding printing medium 40 has been fed to a location immediately preceding the paper sensor 33, and at that time, a check is performed to determine whether the absence of paper is presently detected by detecting whether the preceding printing medium 8 has passed the paper sensor 33. In this case, since the actual length of the preceding printing medium 8 is longer than the length obtained in advance in the printing apparatus, the rotation of the paper feeding roller 31 is halted, or the rotation speed is reduced, so that the succeeding printing medium 40 does not arrive at the paper sensor 33. In Fig. 6D, the preceding printing medium 8 has passed the paper sensor 33 and then the absence of paper is presently detected. At this time, the rotation of the paper feeding roller

31 is resumed at such timing that the interval between the preceding and succeeding printing media 8 and 40 may be equal to the distance L. And finally, in Fig. 6E, the paper feeding process has been completed and the printing of the succeeding printing medium is ~~being~~ performed.

The paragraph starting at page 22, line 8 has been amended as follows.

As described above, according to the present invention, even if the actual length of a printing medium 8 differs from the length set in advance, the paper feeding process is performed correctly, and ~~it is also done so that~~ the cue position of the succeeding printing medium 40 may be ~~controled~~ controlled precisely. Further, the minimum interval L, as required, can be maintained.

The paragraph starting at page 23, line 20 has been amended as follows.

However, if at Step 30 the preceding printing medium 8 is currently being printed, the flow shifts to Step 70, and a position of a trailing edge of the preceding printing medium 8 is calculated. Then at Step 80, according to where ~~is~~ the position of the trailing edge of the preceding printing medium 8 is, it is determined whether a succeeding printing medium 40 can be separated and fed from ~~in~~ the ASF 32. If the preceding printing medium 8 has reached a location where the paper feeding process can be initiated, at Step 90 a consecutive paper feeding routine is activated. Then, when the paper feeding process

has been completed, the flow advances to Step 100 and the paper feeding mode is terminated.

The paragraph starting at page 24, line 7 has been amended as follows.

The initial paper feeding routine will be now described. This routine is initiated at Step 210 in Fig. 8. At Step 220, the calculation of the cue position of a printing medium to be fed is performed, and at Step 230 the rotation of the paper feeding roller 31 at the ASF 32 is begun. Generally, for a serial printer, after printing has ~~been~~ begun, printing media are intermittently delivered in the sub-scanning direction. In order to prevent the precision of the delivery from being deteriorated due to the application of pressure to the fed printing media by the paper feeding roller, a ~~semi-circular~~ semi-circular roller is frequently employed. Therefore, the paper feeding roller 31 is rotated once to complete the paper feeding process, and is then halted. At Step 230, an instruction is issued to start the rotation of the paper feeding roller 3, and at Step 240, a check is performed to determine whether the paper feeding roller 3 has been rotated once. Since at the time the paper feeding process is initiated, the paper feeding roller 31 is not, of course, being rotated, the flow advances to Step 260, whereat the preceding printing medium 8 arrives at the paper sensor 33. If the paper feeding roller 31 has completed the rotation before the preceding printing medium 8 has reached the paper sensor 33, it is determined that a paper feeding failure has occurred because of slippage at the printing medium, or ~~that,~~ that no printing medium is loaded in the ASF 32. The flow then shifts to Step 250,

whereat the occurrence of an error is indicated. At Step 260, at the time when the preceding printing medium 8 has reached the paper sensor 33, the rotation of the ASF 32 is continued until one full revolution has been completed. The flow then advances to Step 270, whereat the rotation of the conveyor roller 9 is performed to complete the feeding of the paper. At this time, the feeding distance of the printing medium 8 is calculated when the paper sensor 33 ~~detectes~~ detects the presence of paper, then the rotation of the conveyor roller 9 is ~~drived~~ driven to feed the preceding printing medium 8 to the cue position. And the initial paper feeding routine is terminated.

The paragraph starting at page 25, line 21 has been amended as follows.

The consecutive paper feeding routine will now be explained referring to Fig. 9. At Step 300, the consecutive paper feeding routine is initiated, and at Step 310, the calculation of the cue position of the succeeding printing medium 40 is begun. Then, at Step 320 the position of the trailing edge of the preceding printing medium 8 is calculated using information concerning the length of the printing medium obtained in advance. The positional information on the trailing edge of the preceding printing medium 8 is subtracted from ~~of~~ the leading edge of the succeeding printing medium 40 to obtain positional difference information. At Step 330, the positional difference information is employed to determine whether the rotation of the paper feeding roller 31 of the ASF 32 should be begun to separate and feed a succeeding printing medium 40. This positional difference information may be either positive or negative, and in this embodiment, positive

information is defined as representing a state wherein there is no overlap of paper, while the negative information is defined as representing there is such overlap. In short, as a condition it is only necessary that the preceding printing medium 8 has already passed the paper feeding roller 31 and thus the succeeding printing medium 40 can be separated and fed. In this embodiment, the positional difference information is used to control the rotation of the paper feeding roller 31. However, information on the distance from the paper feeding roller 31 may be employed regarding the start of the rotation of the paper feeding roller 31. At Step 340, the rotation of the paper feeding roller 31 of the ASF 32 is begun. And at Step 342, the position of the leading edge of the succeeding printing medium 40 is calculated, and at Step 344, it is determined whether the printing medium 8 has reached a location immediately preceding the paper sensor 33. This determination process is repeated until the leading edge of the succeeding printing medium 40 is positioned immediately before the paper sensor 33. When it is determined that the leading edge of the succeeding printing medium 40 has reached the location preceding the paper sensor 33, at Step 350 a check is performed to determine whether the paper sensor 33 indicates the absence of paper based on a detection result of the trailing edge of the preceding printing medium 8. If the absence of paper is not detected, the feeding of the succeeding printing medium 40 is stopped at Step 360. In this embodiment, instead of the slippage of the feeding, the reduction of the feeding speed may be done. In this state, the preceding and succeeding printing media 8 and 40 are fed while overlapping each other, or while there is almost no interval between them. While the paper feeding is halted, the preceding printing medium 8 is independently transported by the conveyor roller 9, which

is a sub-scanning mechanism. Therefore, at a certain time the paper sensor 33 detects the presence of paper. At this time, the minimum required interval between the preceding and the succeeding printing media 8 and 40 is kept, and thereafter, at Step 370 the rotation of the paper feeding roller 31 and the paper feeding are resumed. Subsequently, at Step 380 the conveyor roller 9 is rotated at the same speed as the paper feeding speed, and at Step 390 the preceding printing medium 8 is conveyed in the sub-scanning direction until it reaches the cue position. Then, when the cue position is OK, at Step 400 the consecutive paper feeding routine is terminated.

The paragraph starting at page 28, line 16 has been amended as follows.

As another example, the length information of the printing medium may be a fixed value. In this case, the fast feeding effects obtained by employing consecutive paper feeding vary depending on the length of a printing medium; however, the fixed value information is an effective means to use when the length of a printing medium that is normally used is comparatively fixed. A specific explanation will now be given for a case wherein LETTER size is used as the normally used length of a printing medium, and the sizes A4 and A5 are used as the other lengths. Based on the above embodiment, at the position where the distance L between a preceding printing medium 8 (LETTER size) and a succeeding printing medium 40 is ~~the~~ optimal, the feeding of the succeeding printing medium 40 is always initiated, and the other processes are the same as in the before-mentioned embodiment. Next, it is contemplated that an A4 size printing medium is fed in

this apparatus. Since the A4 size printing medium is longer than the LETTER size printing medium, the paper feeding process is initiated with the printing media interval L being always negative. In this invention, however, since the leading edge of the succeeding printing medium 40 is held at a location immediately preceding the paper sensor 33 until the trailing edge of the preceding printing medium indicates the absence of ~~papers~~ paper, fast consecutive paper feeding can be performed at the optimal printing media interval L. Next, it is contemplated that such a printing medium as A5 size, which is shorter than A4 size, is used. In this case, while the printing media interval L is very large, the paper feeding is performed as controlled in the other points, and no inconvenience is raised. The effects afforded by consecutive paper feeding are merely reduced by the shortage in length of the printing medium. As described above, the provided effects are reduced only when the length of a normally used printing medium is short. In the other cases, however, the effects provided by the fast paper feeding of the present invention are fully demonstrated. Further, in this embodiment, since means for obtaining information on the length of the printing media is not required, the present invention is very effective for a simple printing apparatus.